

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims 1-17 (canceled)

18. (original) A hydraulic machine operable as a pump configured to be driven by a rotating shaft, thereby increasing the pressure of fluid flowing through the pump, the hydraulic machine being further operable as a motor configured to be driven by pressurized fluid, thereby providing torque to a shaft, the hydraulic machine comprising:

a housing, including a high pressure fluid port and a low pressure fluid port;

a plurality of radial pistons, each of the pistons being configured to reciprocate within a corresponding cylinder in the housing, thereby pumping fluid when the hydraulic machine is operating as a pump, and providing torque when the hydraulic machine is operating as a motor, each of the pistons including a corresponding cam follower; and

a cam disposed within the housing, and having a plurality of external lobes configured to cooperate with the cam followers to translate rotational motion of the cam into linear motion of the pistons when the hydraulic machine is operating as a pump, and to translate linear motion of the pistons into rotational motion of the cam when the hydraulic machine is operating as a motor, the cam including an aperture therethrough for receiving a rotatable shaft;

a rotatable valve plate having a plurality of apertures therethrough, at least some of the apertures communicating with the high pressure fluid port and at least some of the apertures communicating with the low pressure fluid port, the valve plate being configured to provide a fluid path between the cylinders and the high pressure fluid port when corresponding pistons are in a power stroke and between the cylinders and the low pressure fluid port when corresponding pistons are in an exhaust stroke, thereby facilitating operation of the hydraulic machine as a motor, the valve plate being further configured to provide a fluid path between the cylinders and the high pressure fluid port when corresponding pistons are in an exhaust stroke and between the cylinders and the low pressure fluid port when corresponding pistons are in a power stroke, thereby facilitating operation of the hydraulic machine as a pump.

19. (currently amended) A hydraulic machine operable as a variable pressure ratio hydraulic transformer for modifying the pressure, flow rate, or a combination thereof, of fluid flowing through the transformer, the transformer comprising:

a housing having at least three housing ports, each of the housing ports being configured to operate as a fluid inlet or as a fluid outlet;

a rotor, rotatably disposed within the housing;

a plurality of pistons attached to the rotor, each of the pistons including a shaft having a generally spherical end, and a head configured to cooperate with the generally spherical end of the shaft, thereby allowing the head to pivot relative to the shaft;

a plurality of cylinders, each of the cylinders being configured to receive a corresponding piston, and having a cylinder axis non-parallel to a corresponding piston shaft;

a first plate configured to be rotatably driven by the rotor, and having a first surface configured to contact one end of each of the cylinders and to allow each of the contacting cylinder ends to slide relative to the first surface, the first plate including a plurality of apertures therethrough, at least some of the apertures being configured to facilitate fluid flow to and from the cylinders; and

a second plate having at least three plate ports therein, each of the plate ports being configured to cooperate with at least one aperture in the first plate and one housing port, thereby facilitating fluid flow between a housing port and at least one cylinder, the second plate being rotatable relative to the housing ports to modify the transformer pressure ratio.

20. (original) A compact hydraulic machine operable as a pump and a motor, and configured to be disposed on a vehicle driving shaft proximate a vehicle wheel, the hydraulic machine comprising:

a housing, including a first housing portion, a second housing portion, and an outer ring, the first housing portion including a high pressure fluid port and a low pressure fluid port, the second housing portion including a plurality of radially oriented cylinders disposed therein, and the outer ring including a tapered bore to facilitate sealing of each of the cylinders;

a plurality of pistons, each of the pistons including a cam follower, and being configured to reciprocate within a corresponding cylinder;

a cam disposed within the housing, and having a plurality of external lobes configured to cooperate with the cam followers to translate rotational motion of the cam into linear motion of the pistons when the hydraulic machine is operating as a pump, and to translate linear motion of the pistons into rotational motion of the cam when the hydraulic machine is operating as a motor, the cam including an aperture therethrough for receiving a rotatable shaft; and

a rotatable valve plate having a plurality of apertures therethrough, and configured to selectively connect the cylinders with the low and high pressure fluid ports, thereby alternately facilitating operation of the hydraulic machine as a pump and a motor.

21. (canceled)

22. (previously presented) A hydraulic machine, comprising:

a housing having one portion with a plurality of radially oriented cylinders disposed therein, and another portion configured to be disposed substantially around the one portion and including a tapered bore to facilitate sealing of the cylinders, the housing including a high pressure fluid port and a low pressure fluid port;

a plurality of pistons, each of the pistons being configured to reciprocate within a corresponding cylinder in the housing and including a corresponding cam follower;

a cam disposed within the housing, and having a plurality of lobes configured to cooperate with the cam followers such that effecting a relative rotational motion between the cam and the housing effects linear motion of the pistons, and effecting linear motion of the pistons effects a relative rotational motion between the cam and the housing; and

a rotatable valve plate having a plurality of apertures therethrough, and configured to selectively connect the cylinders with the low pressure fluid port and high pressure fluid port.

23. (previously presented) The hydraulic machine of claim 22, wherein the housing is configured to be substantially rotationally stationary, such that relative rotational motion between the cam and the housing is effected by rotation of the cam.

24. (new) The hydraulic machine of claim 22, further comprising:
an axial piston; and
a link connecting the axial piston to the valve plate and configured to translate linear motion of the axial piston into rotational motion of the valve plate, thereby facilitating indexing of the valve plate to switch operation of the hydraulic machine between a pump mode and a motor mode.

25. (new) The hydraulic machine of claim 24, further comprising a plurality of weights disposed within the housing and proximate the axial piston, the weights being configured to inhibit movement of the axial piston when the hydraulic machine is operating as a pump at a high speed, thereby indexing the valve plate to reduce the flow of fluid exiting the hydraulic machine.

26. (new) The hydraulic machine of claim 25, further comprising a plurality of two stage spring apparatuses, each of the spring apparatuses being configured to constrain a corresponding one of the weights, a first stage of each of the spring apparatuses maintaining a position of a corresponding one of the pistons relative to the cam such that fluid flow is reduced, a second stage of each of the spring apparatuses maintaining a position of a corresponding one of the pistons relative to the cam such that fluid flow is prohibited.

27. (new) The hydraulic machine of claim 19, wherein the first plate includes a plate portion having the first surface thereon and a separate hub portion attachable to the plate portion, thereby allowing the first surface to receive a smooth finish prior to assembling the plate portion to the hub portion, thereby facilitating sealing between the first surface and the cylinders.

28. (new) The hydraulic machine of claim 19, wherein the plate ports are configured to cooperate with corresponding apertures such that the projected area of the plate ports and portions of the apertures outside the plate ports is generally constant regardless of the position of the second plate relative to the first plate, thereby inhibiting changes in separation forces between the first and second plates.

29. (new) The hydraulic machine of claim 19, wherein the plate ports are configured to facilitate positioning of the first plate relative to the second plate such that fluid passes through the transformer with no substantial pressure change.

30. (new) The hydraulic machine of claim 19, wherein each of the plate ports is generally arcuate, and is disposed at a corresponding radius from a center of the plate, and wherein one of the plate ports is disposed at a larger radius than the other two port plates, thereby providing radial overlap between plate ports.

31. (new) The hydraulic machine of claim 19, further comprising a retainer circumferentially disposed around the cylinders, thereby inhibiting outward movement of the cylinders when the rotor is rotating at a high speed.

32. (new) The hydraulic machine of claim 19, wherein the rotor includes a plurality of shuttle valves each of the shuttle valves being configured to provide a fluid path between a corresponding pair of cylinders, thereby inhibiting pressure spikes as the fluid changes pressure in the transformer.

33. (new) The hydraulic machine of claim 32, wherein each of the shuttle valves includes a shuttle piston configured to inhibit shuttle piston impact at the end of a stroke.

34. (new) The hydraulic machine of claim 18, wherein the housing further includes first and second housing portions, and an outer ring, the first housing portion including the high and low pressure fluid ports, the second housing portion including the cylinders disposed therein, and the outer ring including a tapered bore to facilitate sealing of each of the cylinders.

35. (new) The hydraulic machine of claim 18, further comprising:
an axial piston; and
a link connecting the axial piston to the valve plate and configured to translate linear motion of the axial piston into rotational motion of the valve plate, thereby facilitating

indexing of the valve plate to switch operation of the hydraulic machine between a pump mode and a motor mode.

36. (new) The hydraulic machine of claim 35, further comprising a plurality of weights disposed within the housing and proximate the axial piston, the weights being configured to inhibit movement of the axial piston when the hydraulic machine is operating as a pump at a high speed, thereby indexing the valve plate to reduce the flow of fluid exiting the hydraulic machine.

37. (new) The hydraulic machine of claim 36, further comprising a plurality of two stage spring apparatuses, each of the spring apparatuses being configured to constrain a corresponding one of the weights, a first stage of each of the spring apparatuses maintaining a position of a corresponding one of the pistons relative to the cam such that fluid flow is reduced, a second stage of each of the spring apparatuses maintaining a position of a corresponding one of the pistons relative to the cam such that fluid flow is prohibited.